

REMARKS

Claims 1-19 are pending in the application with claims 12-18 being allowed, claims 1, 3, 4, 7, 9, 11 and 17 being rejected and claims 2, 5, 6, 8, 10, 18 and 19 being objected to.

Reconsideration of the rejected claims and objected to claims is requested.

Claims 1, 3, 4, 7, 9, 11 and 17 stand rejected under 35 USC §103(a) as being unpatentable over Chang ('263) in view of Cadien et al. ('158). The examiner's characteristic of the Chang patent is believed correct including the conclusion that Chang fails to disclose the required tungsten barrier layer. However, the examiner's conclusion that Cadien et al. disclosed an integrated tungsten/tungsten silicide plug process where the required tungsten layer is disclosed is traversed.

Applicant's attorney has carefully reviewed the Cadien et al. patent and is unable to discern any teaching or suggestion in Cadien et al. of using a tungsten barrier layer over any tungsten silicide adhesion layer and then filling the via with a tungsten plug. Cadien et al. describes the use of a tungsten silicide adhesion layer formed over a silicon-based insulating layer where the tungsten silicide is used as the adhesion layer for a tungsten plug. As shown in FIG. 3B and 3C, Cadien et al. discloses lining a via 304 with a tungsten silicide adhesion layer 306 and then using chemical vapor deposition to thereafter deposit a tungsten plug 308 into the via 304. The tungsten forms not only the plug but an overlaying surface 308 (see FIG. 3C) which is then planarized away to form the final configuration shown in FIG. 3D. As shown in each figure of Cadien et al., there is only a single layer of tungsten silicide material between the tungsten plug and the dielectric. There is no suggestion in Cadien et al. of using an additional layer of tungsten as a barrier for the tungsten plug 308.

As set forth in applicant's claims, and as shown in FIG. 4 of applicant's specification, for example, applicant utilizes not only a tungsten silicide layer 12 but in addition a separate identifiable tungsten layer 13 overlaying the tungsten

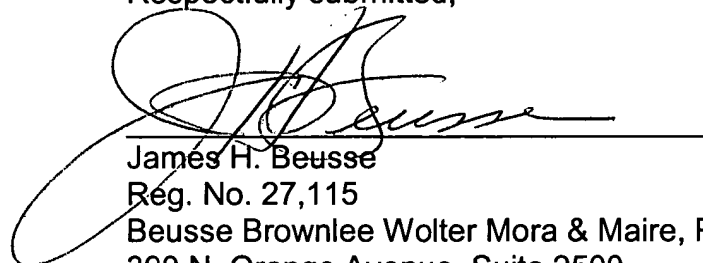
silicide layer. The tungsten forming the plug is deposited as layer 14. Each of the independent claims 1 and 7 recite this separate tungsten barrier layer.

As disclosed in applicant's specification, the use of a tungsten-based film for the tungsten plug eliminates issues associated with the formation of volcanoes that is common with other barrier layers such as titanium or titanium nitride. By using two films, applicant is able to create an adhesion layer that will bond to both the silicon-based material and the tungsten material. The tungsten silicide layer provides such an adhesion layer that has good bonding characteristics for the underlying silicon-based dielectric. The use of the tungsten film provides a barrier layer for the silicon and transitions to the later deposited tungsten plug. The use of the tungsten layer provides for easy nucleation and growth of the tungsten plug. While the present invention adds an additional layer and step in the process of forming tungsten plugs, the improvements obtained from the advantages mentioned above outweigh the downsides of using an extra layer.

Since neither Chang nor Cadien et al. teach or suggest the use of an intermediate tungsten layer between a tungsten plug and a tungsten silicide adhesion layer, it is submitted that the rejection of the claims of this application over the combination of Chang and Cadien et al. is improper and should be withdrawn.

For the reasons set forth above, it is submitted that this application is now in condition for allowance and such allowance is solicited.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "J. Beusse", is written over a horizontal line. The signature is stylized with a large loop at the beginning and end.

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